Spatial noise field characteristics of a temporary three-component small aperture array in Central Italy

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The merits of a seismic array for signal detection and event location are beyond question. The superior signal detection capability is obtained by beamforming and estimating backazimuth and slowness of the seismic wave field by f-k analysis or plane-wave fit gives the parameters for signal classification and event location.
When designing a seismic array, the number of sensors, the respective inter-station distances and the array aperture must be adapted to the wavenumber characteristics of the signals of interest and the local noise field, in order to optimize the signal-to-noise ratio (SNR). For this purpose the statistical structure of signal and noise must be analyzed during the site survey by using a sensor layout that represents as many inter-station distances as possible. Cross-correlation values of signal and noise recordings are calculated for all combinations of sensor pairs in order to determine suitable inter-station distances, such that the array response – once tuned to the signal – suppresses energy reaching the array with wavenumbers, which are characteristic for the local noise field.
During the planning stage of seismic arrays as e.g. of NORESS (Mykkeltveit et al., 1983; Ingate et al., 1985; Mykkeltveit et al., 1990) or of GERESS (Harjes, 1990), it became a sort of “standard procedure” to calculate the cross-correlation values for signals with infinite apparent velocities. As pointed out by Schweitzer et al. (2002) this procedure disregards possible directional dependencies of the noise field.
The aim of the present contribution is to study if this ad-hoc assumption is sufficient to describe the local noise conditions or if it results in wrong estimates of the noise field. Therefore, we compare the classic approach for noise correlations with one based on time shifts between the single traces (noise beams), to simulate coherent, azimuth dependent noise propagation.
As test dataset we use data from a small aperture 9-element array, realized temporarily in the Upper Tiber Valley near Città di Castello (CDC) during October 2000 (Braun et al., 2004).

References

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